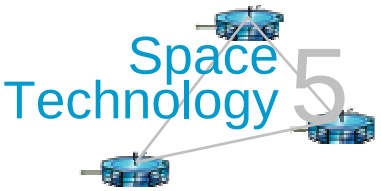


Space Technology 5 Mission

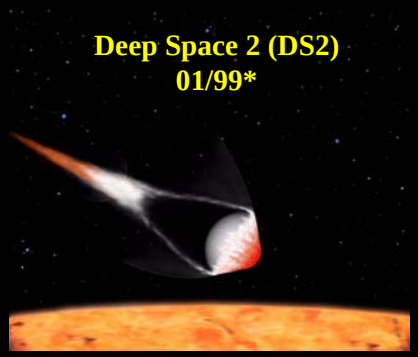
CLUSTER SWT MEETING

March 4, 2002

J.A. Slavin
ST 5 Project Scientist

New Millennium Program Overview

Deep Space 1 (DS1)
10/98*

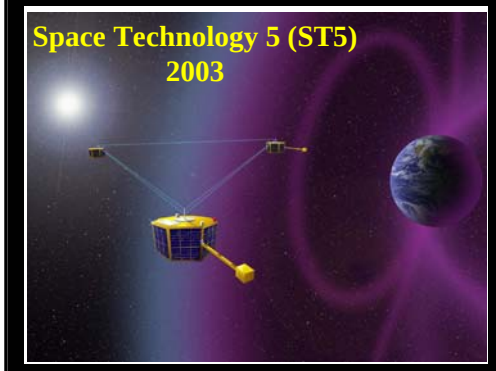


Deep Space 2 (DS2)
01/99*

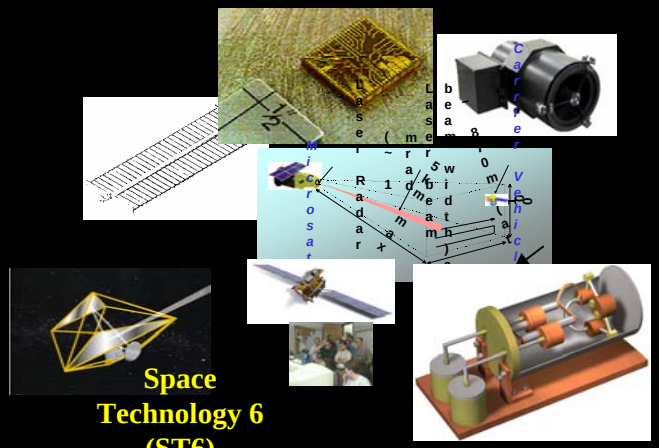
Earth Orbiting 1 (EO1)
11/00*

Earth Observing 3 (EO3)
2004

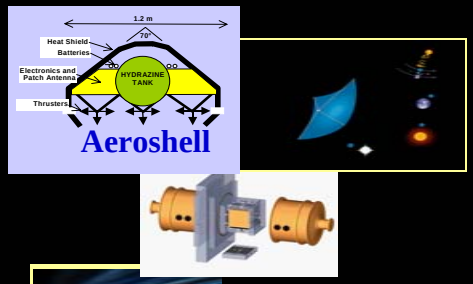
A cross-Enterprise program to identify and flight validate breakthrough technologies that will significantly benefit future Space Science and Earth Science missions.



Space Technology 5 (ST5)
2003



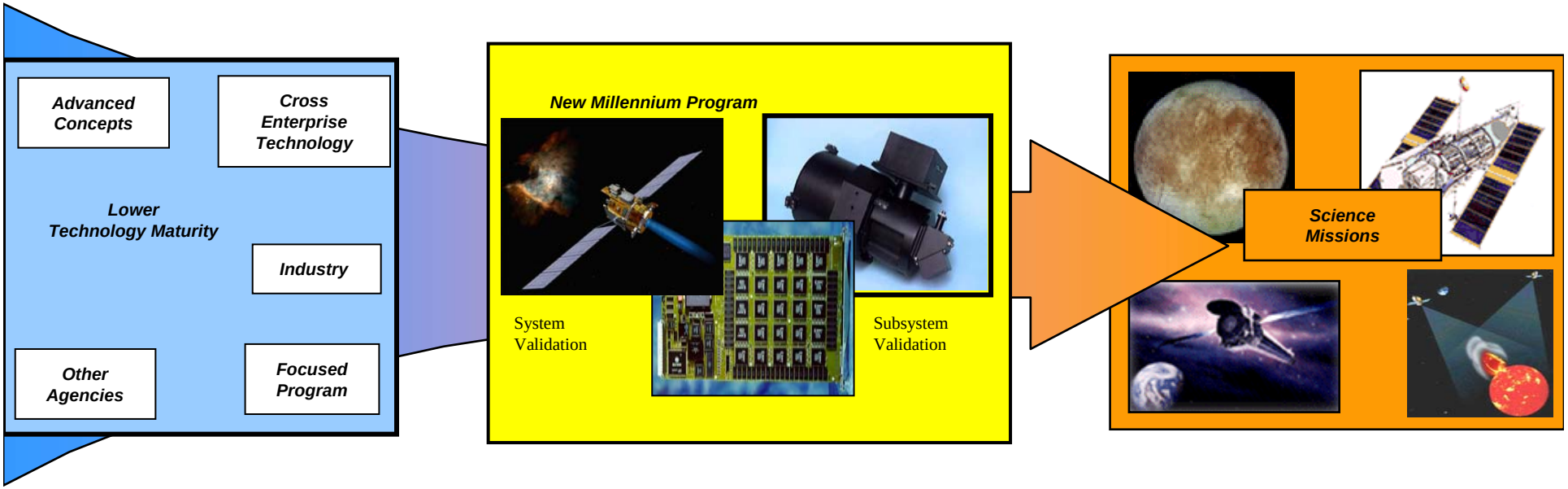
Space
Technology 6
(ST6)
2003-2004

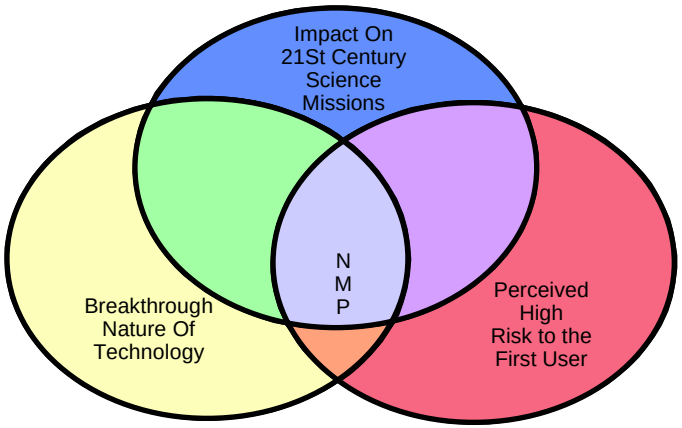


Space Technology 7
(ST7)
2004-2005

* Actual Launch Date

Flight Validation of Breakthrough Technologies to Benefit Future Space and Earth Science Missions





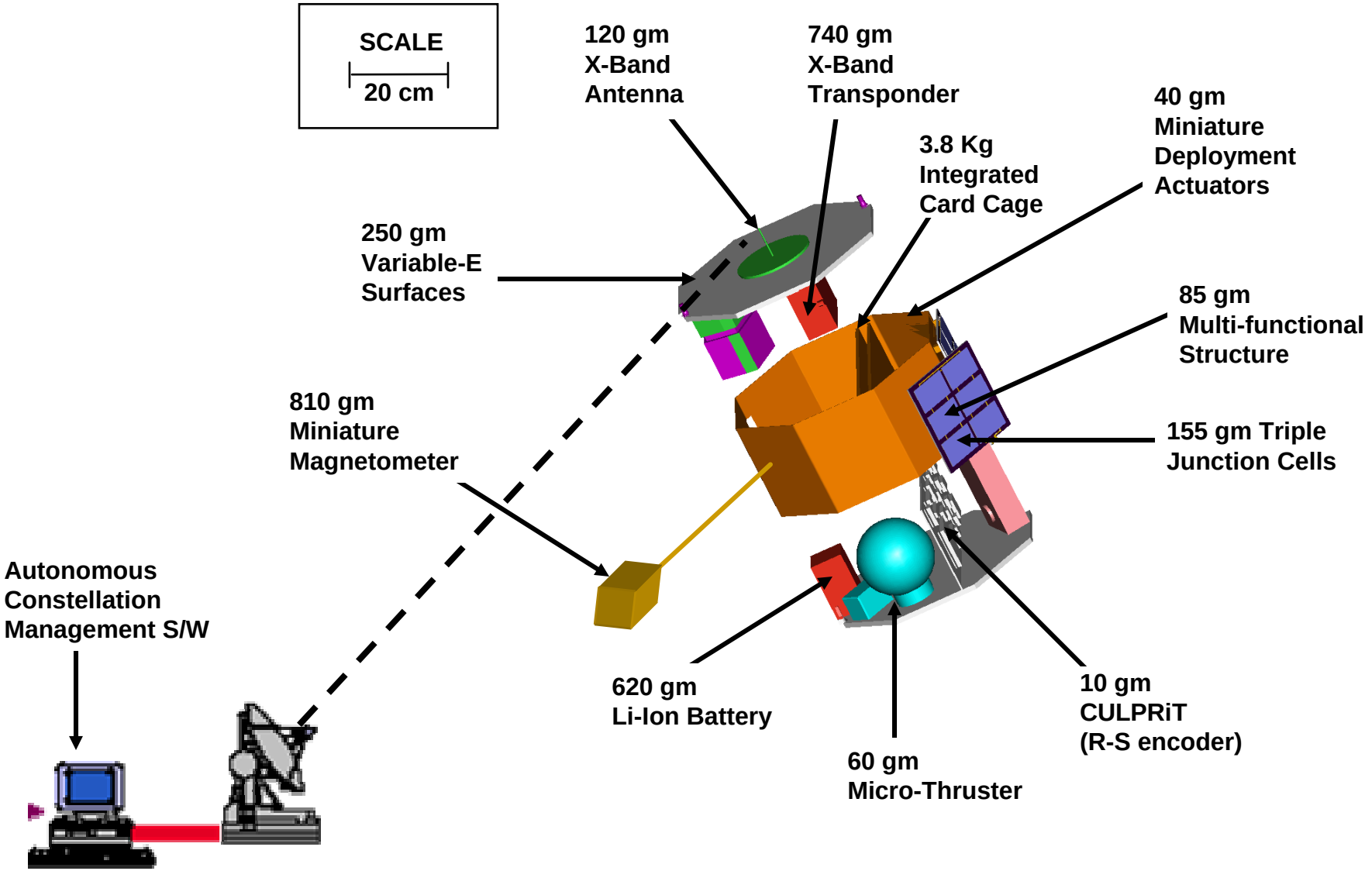
Breakthrough technologies

- Enable new capabilities to meet Earth and Space Science needs
- Reduce costs of future missions

Flight validation

- Mitigates risks to first users
- Enables rapid technology infusion into future missions

ST-5 Technologies



ST 5 Project Concept

Space Technology 5

Miniature Spacecraft

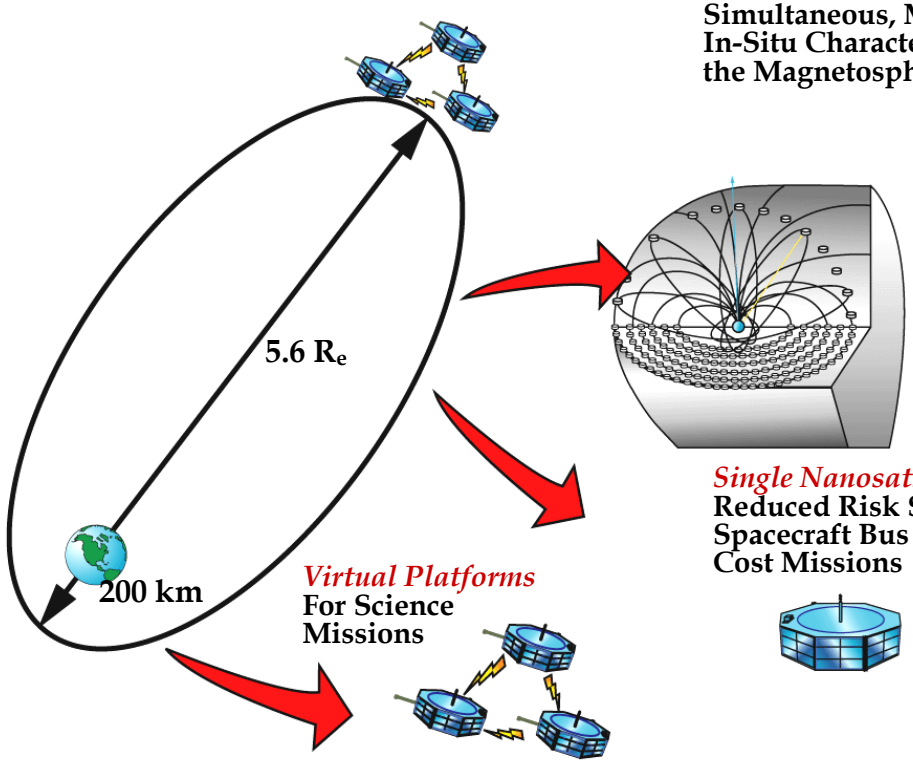
- Systems Design Integration and Test Technologies

Candidate Spacecraft Technologies

- 5V bus - 1/4V logic
- Li-Ion batteries
- Miniature transponder
- Miniature Thrusters
- Multi-functional structure
- Variable emittance coatings

Constellation Control, Coordination, and Operations Architecture

- Ground system autonomy
- Low cost operations



Constellation Class Missions
Simultaneous, Multipoint, In-Situ Characterization of the Magnetosphere

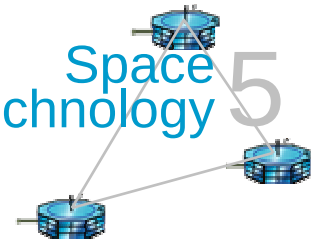
Single Nanosats and Probes
Reduced Risk Small Spacecraft Bus for Low Cost Missions

Virtual Platforms
For Science Missions

TECHNOLOGY **VALIDATION** **INFUSION**

J.A. Slavin
ST 5 Project Scientist

ST-5 Mission Goals

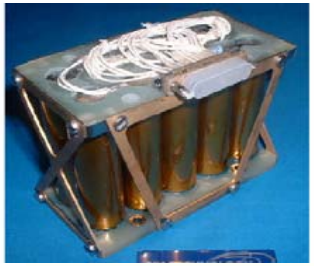


The ST-5 mission has the following level-one mission requirements:

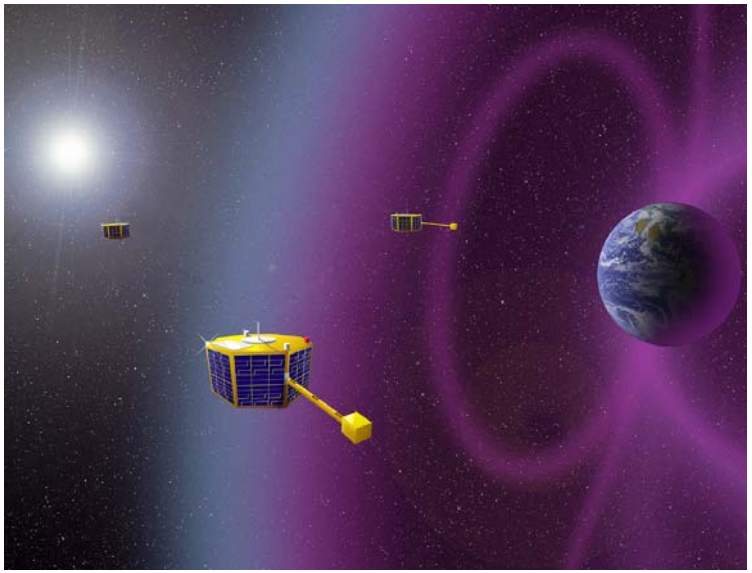
1. ***Design, develop, integrate, and operate a full service 20-kg class spacecraft through the use of NMP assigned technologies;***
2. ***Demonstrate the ability to support accurate, research quality scientific measurements using this class of spacecraft;***
3. ***Design, develop, and operate multiple spacecraft to act as a single constellation rather than as individual elements.***

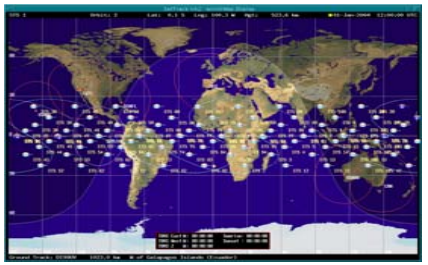
ST5 TECHNOLOGIES

Space Technology 5

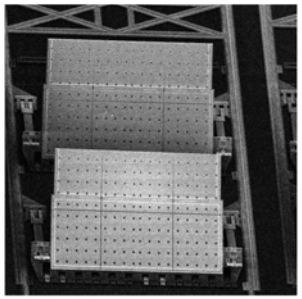


Li-ion battery

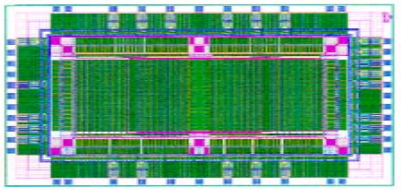




Autonomous ground operations



Variable emittance thermal coating



Ultra-low power electronics

X-band transponder

Multi-functional structure

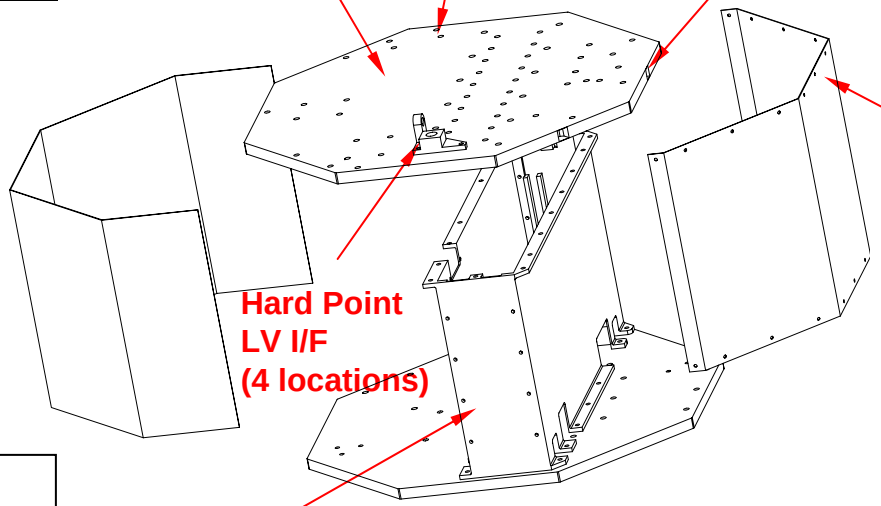
Micro-thruster

ST5 – IMPLICIT TECHNOLOGIES

Space Technology 5

Miniature actuators

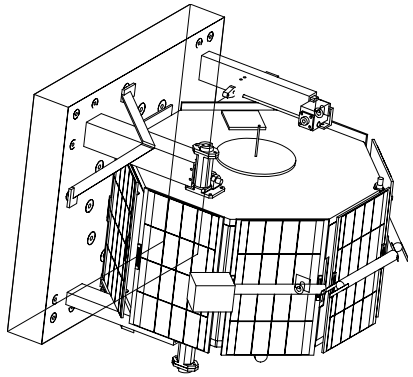
Miniature magnetometer



Miniature passive nutation damper

Miniature sun sensor

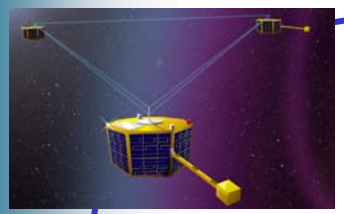
Low-voltage bus



Deployer mechanism

System Verification/Validation Overview

Space Technology 5



Micro-Satellite Design and Build

"Design, development, integration, test and operation of a full service 20 kg class spacecraft through the use of multiple new technologies"

- Full Functional Spacecraft
  - Spacecraft Mass Properties
  - Appendage Deployments
  - Pointing Performance
- Radiometric Performance
  - X-Band Technology
- Secondary Payload Launch
  - Volume Limitations
  - Separation System
- Radiation Environment

Research-Quality Spacecraft

"The ability to achieve accurate research-quality scientific measurements using a 20 kg-class spacecraft"

- Time Knowledge
- Platform for In-situ Measurements
  - Vehicle Magnetic Sig
  - Support "Science Grade" Magnetometer
- Autonomous Cooperative Data Collection (Science Event Warning)

Constellation Mission

"The design, development, and operation of multiple spacecraft to act as a single constellation rather than as individual elements"

- Constellation Mission
  - Coordinating Mission Geometry
  - Processing of Data Streams from Multiple Spacecraft
- Autonomous Constellation Management
  - SatTrack Technology
- "Lights Out" Ops

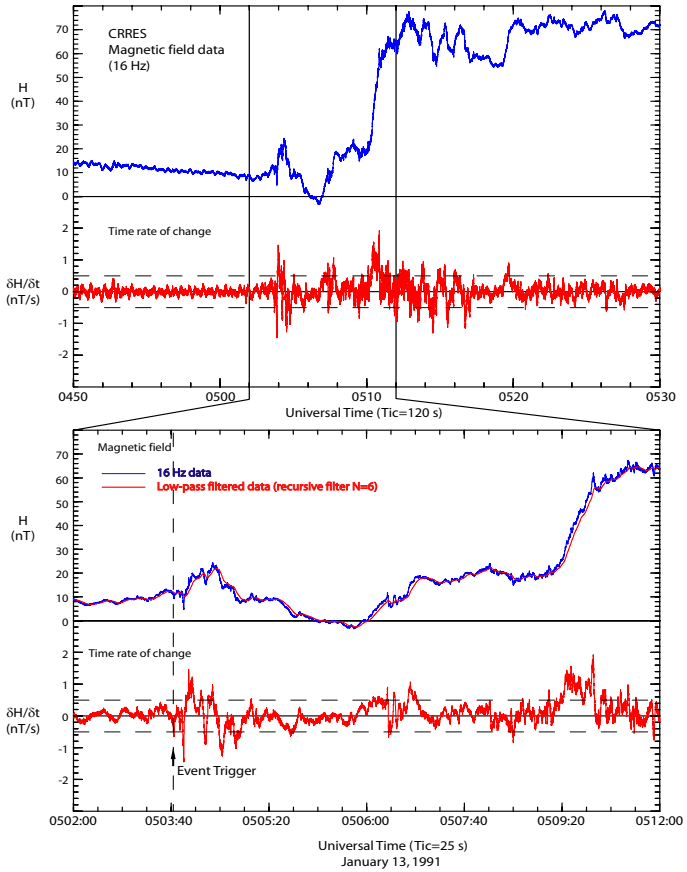
J.A. Slavin
ST 5 Project Scientist

Science Validation

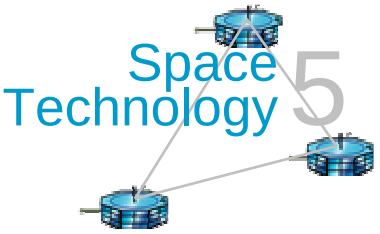
Space Technology 5

Flight validate:

- **Miniaturized, research-grade vector magnetometer**
- **ST-5 capability to act as a platform for taking in situ magnetic field measurements**
- **Autonomous operations and response to science events**
- **Constellation-level cooperative data collection during science events**



Chronological History of ST-5

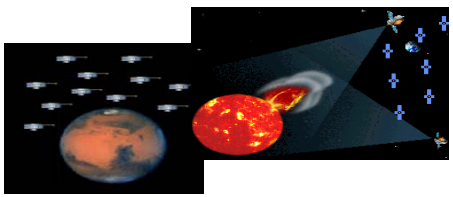


Jul '99:	***GSFC ST-5 Proposal submitted***
Aug '99:	***GSFC Proposal accepted***
May '00:	***Systems Concept Review***
Feb '01:	***Science Validation MAG selected***
June '01:	***Preliminary Design Review***
Nov '01:	***HQ Confirmation***
June '02:	***Critical Design Review***
May '04:	***Launch Readiness Date***

J.A. Slavin
ST 5 Project Scientist

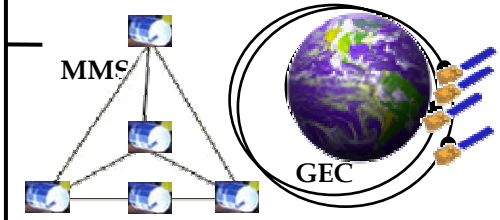
SEC Roadmap Constellation Missions

Space Technology 5



Mid-term Missions:
- Magnetospheric Constellation
- Inner Magnetospheric Constellation
- Dayside Boundary Constellation
- Global ITM Constellation

Far-term Missions:
- Solar Flotilla
- Inner Heliospheric Constellation
- Outer Heliospheric Radio Imager
- Planetary Constellations



Near-term Missions:
- Magnetospheric Multiscale
- Geospace Electrodynamic Connections

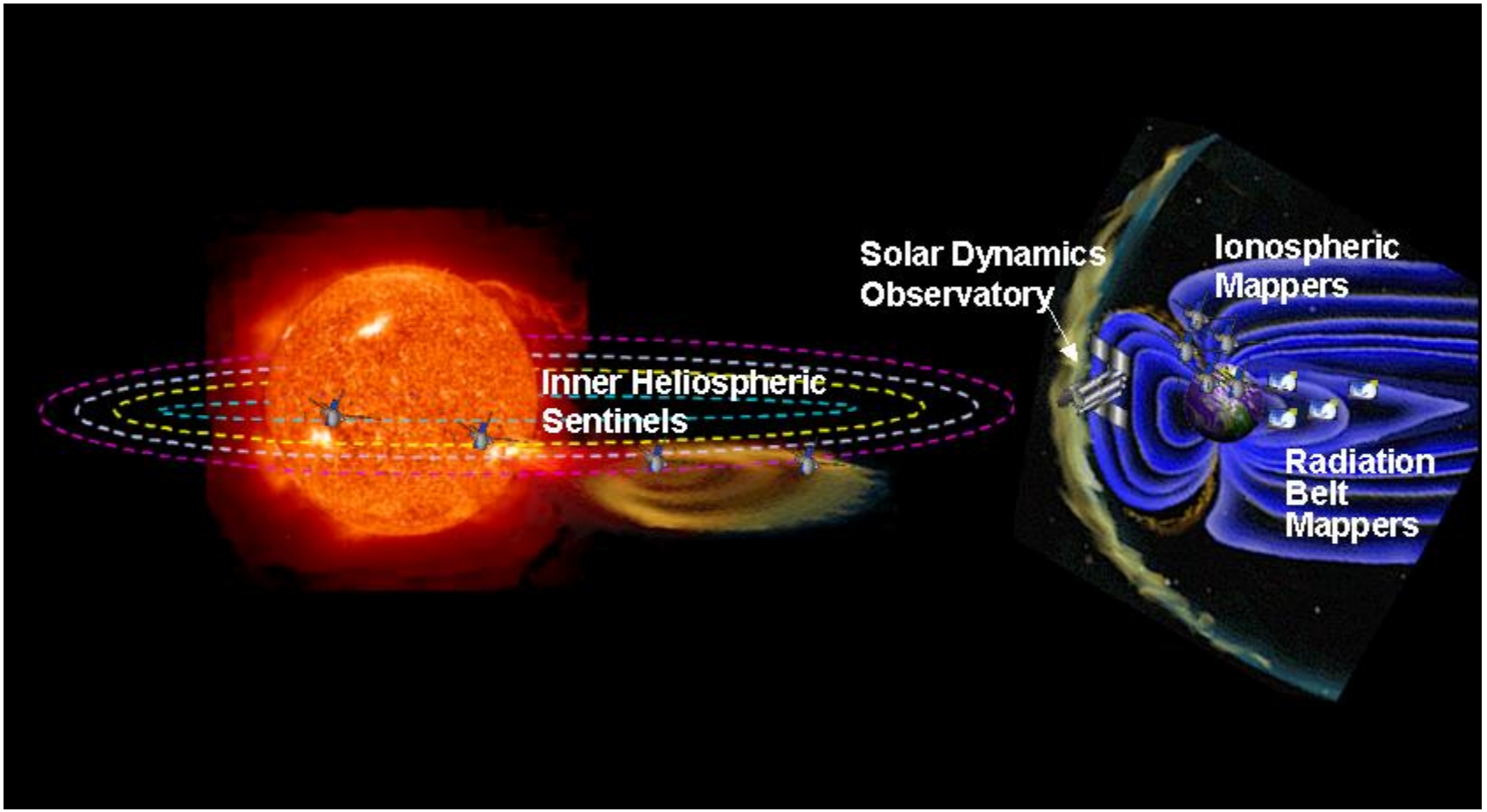
Cost ($M)	Number of spacecraft	Mass (kg)
1	100	10
10	10	100
100	1	1000

5 10 15
Years

J.A. Slavin
ST 5 Project Scientist

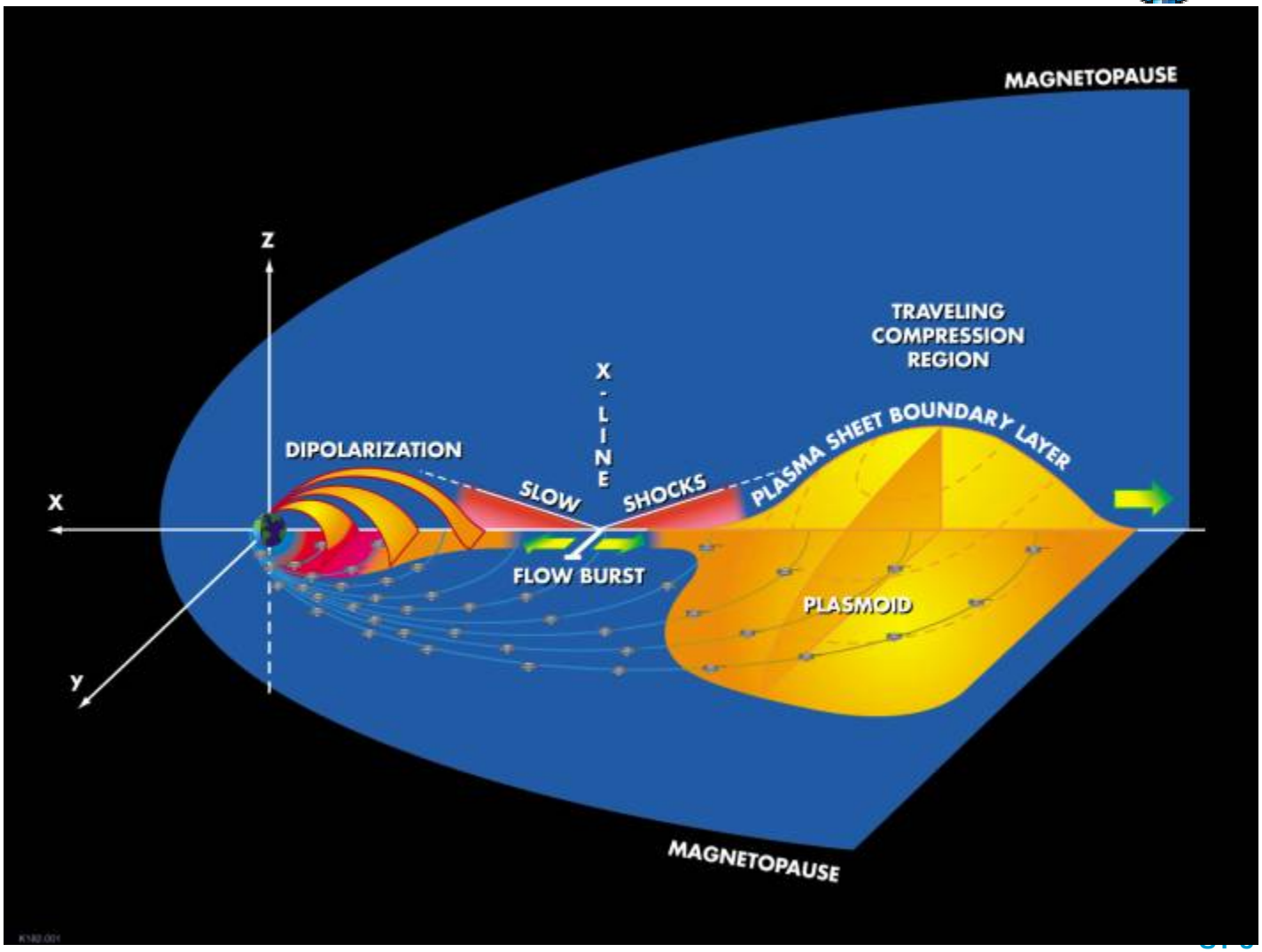
ST-5: Enabling the Future - LWS 2009

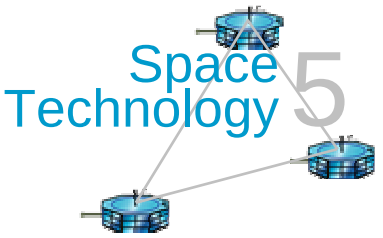
Space Technology 5



ST-5: Enabling the Future - MagCon 2011

Space Technology 5





ST-5 Benefits to NASA

- ***Pathfinder for all missions requiring highly capable, small spacecraft - whether strategic (e.g., LWS/IT/RB and STP/MagCon) or selected for development through the Explorer, Discovery and Earth Probes Programs;***
- ***Pathfinder for constellation mission operations, autonomy, communications, manufacturability, costing, scheduling and reliability;***
- ***Flight validation vehicle for miniaturized subsystems (e.g., sun sensor, X-Band transponder, CCNT, magnetometer, etc.);***
- ***Pathfinder for secondary launches as a means of reducing cost for near-earth scientific spacecraft (e.g., LWS Geospace monitors).***